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• **PATENT ABSTRACTS OF JAPAN vol. 1999, no.
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• **"DIGITAL VISUAL INTERFACE DVI" PAPER
DIGITAL DISPLAY WORKING GROUP, XX, XX, 2
April 1999 (1999-04-02), pages 1-76, XP002948299**

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Description

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0001] This invention relates to a display apparatus connected to a host such as a graphics card in a computer for displaying images based on signals from the host.

(2) Description of the Related Art

[0002] In general, the documents "Patent Abstracts of Japan, vol. 1999, no. 13, 30 Nov. 1999" and JP-11-23 1994-A disclose a display apparatus connected to a plurality of displays.

[0003] However, these documents do not relate to a display apparatus connected to a host, to which arrangement this invention relates.

[0004] Interface with a D-Sub connector, which is a typical type of analog interface, is chiefly used to connect a graphics card in a computer with a display apparatus.

[0005] The D-Sub connector is also called a 15-pin D-Shell display connector, a standard 15-pin VGA (Video Graphics Adapter) connector, or a VGA connector conforming to MIL-C-24308 Standard. In this specification, it will be called a VGA connector and the type of analog interface using this connector will be called a VGA interface. In this case, digital signals are converted to analog signals in the graphics card and the analog signals are transmitted to the display apparatus. The display apparatus processes the analog signals therein to display images.

[0006] Recently, it has become technically possible that display apparatus such as liquid crystal display apparatus accept digital signals as they are, and process and visualize these signals. Along with this trend, DVI-I, a digital interface using a new connector which is quite different from the VGA connector in shape, has been developed, and display apparatus having such interface are becoming commercially available.

[0007] DVI-I is the abbreviation of Digital Visual Interface Integrated which is the interface type that handles both TMDS (Transition Minimized Differential Signaling) digital signals and RGB (red, green and blue) analog signals.

[0008] The DVI-I standard is based on the DVI standard, which is defined in the specification document "Digital Visual Interface DVI", Revision 1.0, Digital Display Working Group (DDWG), 02 April 1999, XP002948299.

[0009] A display apparatus having the DVI-I interface has a problem such that it cannot be physically connected to the graphics card having the VGA interface without a VGA/DVI-I conversion cable.

[0010] Even if the display apparatus is physically connected to the graphics card by using such a conversion cable, there is still another problem as mentioned hereinafter.

[0011] A computer operating system (hereinafter called an OS) today performs what is known as the Plug-and-Play function. Thus, when a Plug-and-Play compatible display apparatus is connected to a graphics card in a computer, the OS of the computer selects a driver (software) appropriate for display of images and automatically makes optimal settings for proper display.

[0012] To realize this function, the Plug-and-Play compatible display apparatus has specification information already stored in its memory, which is to be transmitted to the graphics card. This specification information is called EDID (Extended Display Identification Data), and includes, for example, the resolution, frequency of vertical scan signals, frame rate, vender code indicating the manufacturer's name, and the serial number of the display apparatus. Naturally, this information varies with models of display apparatus. Even display apparatus of the same model may have different information according to the interface type employed by the display apparatus.

[0013] Consequently, even when a graphics card having the VGA interface and a display apparatus having the DVI-I interface are connected through the conversion cable, EDID may not be transmitted normally to the graphics card. Even when EDID is transmitted, the Plug-and-Play function may not be performed normally. Then, no images will be displayed on the screen of the display apparatus, or appropriate display will not be achieved according to the specification of the display apparatus.

SUMMARY OF THE INVENTION

[0014] This invention has been made having regard to the state of the art noted above, and its object is to provide a display apparatus for selectively outputting appropriate specification information corresponding to the interface type on the host side to display images properly according to the specifications. The above object is fulfilled, according to this invention, by a display apparatus as defined in any one of the appended claims.

[0015] In particular, according to an aspect of this invention, a display apparatus for displaying images based on signals received from a host comprises: a connector receptacle for receiving a connector of a predetermined interface type, via which the signals from the host are received; determining means for determining an interface type of said host based on a voltage value of a particular DC power line among the signals received from said host via said connector receptacle; a plurality of storage means each storing specification information relating to display for one of interface types of said host, which are connectable to said display apparatus; and output means for selecting one of said plurality of storage means in response to said voltage value of said particular DC power line based on a result of determination by said determining means, and outputting specification information of the selected one of said storage means to the host, which corresponds to the interface type determined

by said determining means.

[0016] Signals from the host such as a graphics card in a computer reflect the interface type of the host. The determining means can determine the interface type from these signals. Alternatively, the user may manually operate a selector switch or the like, whereby the determining means may determine the interface type based on the state of the switch. The output means outputs specification information corresponding to the interface type determined, from one of the storage means to the host. Consequently, the host can make optimal settings for proper display according to the specification information.

[0017] Thus, according to this invention, the display apparatus can display images properly according to its specification even when the interface type of the host is different from that of the display apparatus.

[0018] Preferably, the determining means is arranged to discriminate between the latest DVI-I interface and the conventional VGA interface.

[0019] In this case, the output means outputs appropriate specification information corresponding to the interface type, whichever is employed by the host, so that images can be displayed properly according to the specification of the display apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] For the purpose of illustrating the invention, there are shown in the drawings several forms which are presently preferred, it being understood, however, that the invention is not limited to the precise arrangement and instrumentalities shown.

Fig. 1 is an overall view of a computer system including a display apparatus according to this invention;
Fig. 2 is a block diagram of a principal portion of the display apparatus; and
Fig. 3 is a view showing a conversion cable.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Preferred embodiments of the present invention will be described in detail hereinafter with reference to the drawings.

[0022] Referring to Fig. 1, a computer 1 has a keyboard 3 and a mouse 5 connected thereto for inputting instructions and the like. The computer 1 outputs images and other data to a display 8 through a graphics card 7 inserted into an extended slot of the computer 1. The display 8 has a receptacle 9 formed adjacent to the rear thereof for receiving a DVI-I connector for the DVI-I interface.

[0023] The graphics card 7 corresponds to the host of this invention. This graphics card 7 may be the VGA interface type, or the DVI-I interface type.

[0024] Where the interface type is different, signals from the graphics card 7 and a voltage to a DC power line are different. Specification information called EDID

is also different, which is outputted from the display 8 to the graphics card 7 to allow proper display of images on the display 8. The EDID acts on the OS of computer 1 most effectively where the OS supports the Plug-and-Play function.

[0025] Where, for example, the graphics card 7 employs the VGA interface and the display 8 employs the DVI-I interface, the graphics card 7 and display 8 must be connected through a conversion cable 13 having, at both ends thereof, a VGA connector acting as a receptacle 10 and a DVI-I connector acting as a plug 11. The DVI-I connector 11 has a 5V line for DDC (Display Data Channel) which is grounded as described hereinafter.

[0026] Where both the graphics card 7 and the display 8 employ the DVI-I interface, the graphics card 7 and display 8 may be connected through a usual video cable, i.e. one for the DVI-I interface.

[0027] The display 8 includes a display screen such as a liquid crystal display screen, and an ASIC 21 for controlling this display screen (Fig. 2). The ASIC 21 has a TMDS signal line 21a which is a digital signal line, RGB signal lines 21b-21d, a horizontal synchronizing signal line 21e and a vertical synchronizing signal line 21f, all extending from the DVI-I connector receptacle 9 to the ASIC 21. Through this ASIC 21 signals are exchanged between various components (not shown) of the display 8.

[0028] The display 8 includes two EDID storage memories 23 and 25 which correspond to the storage means of this invention. The EDID storage memory 23 is for the VGA interface and the EDID storage memory 25 is for the DVI-I interface. These memories 23 and 25 store EDID corresponding to the respective interfaces. Synchronously with a clock from a DDC clock line 27 received at serial clock terminals 23a and 25a, the memories 23 and 25 output the EDID from serial data terminals 23b and 25b to a DDC data line 29.

[0029] The storage means are not limited to the two EDID storage memories 23 and 25. The number of memories may be varied with the number of interface types to be accommodated. Each memory may be selected for each interface type by a multiplexer 31.

[0030] The serial clock terminals 23a and 25a of EDID storage memories 23 and 25 are connected to input terminals A0 and A1 of multiplexer 31. The serial data terminals 23b and 25b are connected to input terminals B0 and B1 of multiplexer 31. Output terminals A and B of multiplexer 31 are selectively connected to the input terminal A0 or A1 and the input terminal B0 or B1, respectively, according to a voltage at a selector terminal 31a. In this embodiment, when the voltage at the selector terminal 31a is "0V" or thereabout, the output terminals A and B are connected to the input terminals A0 and B0, respectively. When the voltage is "5V" or thereabout, the output terminals A and B are connected to the input terminals A1 and B1, respectively.

[0031] The multiplexer 31 corresponds to the determining means and output means of this invention.

[0032] A power line Vcc1, which is connected to the primary source of display 8 for supplying 5V DC voltage, is connected to the EDID storage memory 23 and to the multiplexer 31 through a backflow preventing diode D3 which prevents reverse flow of current. Power is constantly supplied to the EDID storage memory 23 and multiplexer 31 during the operation of the display 8, including the operation in a power save mode. The horizontal synchronizing signal line 21e and vertical synchronizing signal line 21f are connected to the power terminal of EDID storage memory 23 through a rectifier diode D1. The rectifier diode D1 forms a peak hold circuit PH in combination with a capacitor C1 connected between the power terminal and a grounding terminal. That is, when the power line Vcc1 is at "0V", power needed for the operation is obtained from the graphics card 7.

[0033] A power line Vcc2 (5V line for DDC) is connected to the selector terminal 31a of multiplexer 31, and is grounded through a resistor R1. Consequently, even when the power line Vcc2 is opened instead of being grounded, the selector terminal 31a is forcibly reduced to "0V" unless a voltage is applied.

[0034] Further, the power line Vcc2 is connected directly to the power terminal of EDID storage memory 25, and through a DC backflow preventing diode D2 to the power terminal of EDID storage memory 23. This backflow preventing diode D2 prevents a current from the peak hold circuit PH from flowing into the power line Vcc2. The backflow preventing diode D2 also prevents the current from flowing to the selector terminal 31a of multiplexer 31 in order not to reverse the operation of multiplexer 31.

[0035] Referring to Fig. 3, the conversion cable 13 extends between the DVI-I connector 11 and the VGA connector 10. The DVI-I connector 11 has a power line Vcc3 (5V line for DDC) which is grounded.

[0036] For the reason noted hereinbefore, this power line Vcc3 may be opened instead of being grounded.

[0037] The RGB signal lines 21b-21d, horizontal synchronizing signal line 21e, vertical synchronizing signal line 21f, DDC clock line 27 and DDC data line 29 are connected to the corresponding terminals of the DVI-I connector 11 and the VGA connector 10.

[0038] Operation of the apparatus having the above construction will be described next.

<DVI-I connector>

[0039] Where the graphics card 7 has a connector of the DVI-I interface, the graphics card 7 and display 8 are connected through a digital video cable (not shown) having DVI-I connectors at both ends thereof.

[0040] In this case, 5V voltage for DDC is supplied to the power line Vcc2 to supply power to the multiplexer 31 and is also supplied to both EDID storage memory 23 and EDID storage memory 25, thereby activating the two memories 23 and 25. The 5V voltage is applied to the selector terminal 31a of multiplexer 31.

[0041] Consequently, the input terminals A1 and B1 of multiplexer 31 are selected and only the operative state of the EDID storage memory 25 is transmitted to the graphics card 7 even though both EDID storage memories 23 and 25 are activated.

«When power to the display is off»

[0042] When power supply to the display 8 is completely cut off, the power line Vcc1 becomes "0V". However, power is supplied from the power line Vcc2 to the EDID storage memory 25 and to the multiplexer 31. Consequently, even though the display 8 is turned off, the EDID is normally transmitted to the graphics card 7 to perform the Plug-and-Play function normally.

<VGA connector>

[0043] Where the graphics card 7 has a connector of the VGA interface, the graphics card 7 and display 8 are connected through the conversion cable 13.

[0044] The display 8 supplies power to the power line Vcc1 to activate the EDID storage memory 23 and the multiplexer 31. Since the power line Vcc2 is grounded, the selector terminal 31a of multiplexer 31 becomes "0V", whereby it selects the input terminals A0 and B0. Consequently, the EDID is outputted from the EDID storage memory 23.

[0045] Since no power is supplied to the EDID storage memory 25 which is unnecessary in this case, a relatively small power capacity generated in the peak hold circuit PH will not be wasted.

«When power to the display is off»

[0046] When power supply to the display 8 is completely cut off, except in the power save mode for reducing power consumption by the display 8, the power line Vcc1 becomes "0V".

[0047] However, the peak hold circuit PH supplies power to the EDID storage memory 23 and to the multiplexer 31.

[0048] Consequently, even though the display 8 is turned off, the EDID is normally transmitted to the graphics card 7 to allow proper display of images.

[0049] This invention is not limited to the construction in the foregoing embodiment, but may be modified as follows:

(1) In place of the above conversion cable, a simple VGA/DVI-I conversion cable not having, at its DVI-I end, any DDC 5V line which is opened or grounded may be used. In this case, the inputs to the multiplexer may be switched by manually operating a switch disposed at the rear of the display. The DVI-I connector may have a projection or the like formed thereon. When this projection enters a recess formed at the rear of the display, a selector

switch therein may be operated automatically to switch the inputs to the multiplexer.

(2) The storage means may be a single physical memory having an internal storage region logically divided to store EDID corresponding to a plurality of interface types. In this case, for example, the interface type may be determined by a microcomputer, and the EDID corresponding to the interface type may be retrieved from the memory and outputted in response to a serial clock detected by the microcomputer.

(3) The interface type is not limited to the described combination of the VGA interface and the DVI-I interface. The same advantages may be secured for other interface types by devising a way of distinguishing one type from another.

[0050] The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

[0051] A display apparatus for displaying images based on signals received from a host. The apparatus includes a determining means for determining an interface type of the host, a plurality of storage means each storing specification information relating to display for one of interface types to be connected, and an output means for outputting, from one of the storage means to the host, the specification information corresponding to the interface type determined by the determining means.

Claims

1. A display apparatus (8) for displaying images based on signals received from a host (1), comprising:

a connector receptacle (9) for receiving a connector of a predetermined interface type, via which the signals from the host are received; determining means (31) for determining an interface type of said host based on a voltage value of a particular DC power line among the signals received from said host via said connector receptacle;

a plurality of storage means (23; 25) each storing specification information relating to display for one of interface types of said host, which are connectable to said display apparatus; and output means (31) for selecting one of said plurality of storage means in response to said voltage value of said particular DC power line based on a result of determination by said determining means, and outputting specification information of the selected one of said storage means to the host, which corresponds to the interface type

determined by said determining means.

2. A display apparatus as defined in claim 1, wherein said determining means is arranged to discriminate, as the interface types of said host, between the DVI-I interface and the VGA interface, wherein DVI stands for Digital Visual Interface Integrated and VGA stands for Video Graphics Adapter.
3. A display apparatus as defined in claim 1 or 2, wherein said plurality of storage means comprise two storage means, one for the DVI-I interface, and the other for the VGA interface, said storage means for the DVI-I interface being powered by said host only when the interface type is the DVI-I interface.
4. A display apparatus as defined in claim 3, further comprising a peak hold circuit for generating a DC voltage based on synchronizing signals received from said host, said DC voltage generated by said peak hold circuit being supplied only to said storage means for the VGA interface and to said output means.
5. A display apparatus as defined in claim 4, further comprising a backflow preventing diode disposed between said peak hold circuit and said storage means for the DVI-I interface for blocking a DC current flowing from said peak hold circuit.
6. A display apparatus as defined in claim 2, wherein said connector receptacle is arranged to receive a connector of the DVI-I interface of a VGA to DVI-I conversion cable having, at its DVI-I connector, a 5V line for DDC which is opened or grounded, wherein DDC stands for Display Data Channel.
7. A display apparatus as defined in any one of claims 1 to 6, wherein said specification information is EDID necessary for a Plug-and-Play function, wherein EDID stands for Extended Display Identification Data.

Patentansprüche

1. Anzeigevorrichtung (8) zum Anzeigen von Bildern basierend auf von einem Host (1) empfangenen Signalen, mit:

einer Steckerbuchse (9) zum Aufnehmen eines Steckers eines vorbestimmten Schnittstellentyps, über die die Signale von dem Host empfangen werden;

einer Bestimmungseinrichtung (31) zum Bestimmen eines Schnittstellentyps von dem Host basierend auf einem Spannungswert einer bestimmten Gleichspannungsleitung aus den Signalen, die über die Steckerbuchse von dem

- Host empfangen werden;
 einer Vielzahl von Speichereinrichtungen (23;
 25), die jeweils Spezifikationsinformationen mit
 Bezug auf eine Anzeige für einen von Schnitt-
 stellentypen von dem Host speichern, die mit
 der Anzeigevorrichtung verbindbar sind; und
 einer Ausgabeeinrichtung (31) zum Auswählen
 von einer der Vielzahl von Speichereinrichtun-
 gen in Erwiderung auf den Spannungswert der
 bestimmten Gleichspannungsleitung basierend
 auf einem Bestimmungsergebnis durch die Be-
 stimmungseinrichtung und Ausgeben von Spe-
 zifikationsinformationen der Ausgewählten der
 Speichereinrichtungen an den Host, die dem
 durch die Bestimmungseinrichtung bestimmten
 Schnittstellentyp entsprechen.
2. Anzeigevorrichtung gemäß Anspruch 1, wobei die
 Bestimmungseinrichtung eingerichtet ist, zwischen
 der DVI-I-Schnittstelle und der VGA-Schnittstelle als
 den Schnittstellentypen von dem Host zu unterschei-
 den, wobei DVI für "Digital Visual Interface Integra-
 ted" steht und VGA für "Video Graphics Adapter"
 steht.
3. Anzeigevorrichtung gemäß Anspruch 1 oder 2, wo-
 bei die Vielzahl von Speichereinrichtungen zwei
 Speichereinrichtungen aufweist, eine für die DVI-I-
 Schnittstelle und die andere für die VGA-Schnittstel-
 le, wobei die Speichereinrichtung für die DVI-I-
 Schnittstelle nur dann durch den Host mit Energie
 versorgt wird, wenn der Schnittstellentyp die DVI-I-
 Schnittstelle ist.
4. Anzeigevorrichtung gemäß Anspruch 3, zusätzlich
 mit einer Spitzenwerthalteschaltung zum Erzeugen
 einer Gleichspannung basierend auf von dem Host
 empfangenen Synchronisationssignalen, wobei die
 durch die Spitzenwerthalteschaltung erzeugte
 Gleichspannung nur an die Speichereinrichtung für
 die VGA-Schnittstelle und an die Ausgabeeinrich-
 tung geliefert wird.
5. Anzeigevorrichtung gemäß Anspruch 4, zusätzlich
 mit einer rückflussverhindernden Diode, die zw-
 ischen der Spitzenwerthalteschaltung und der Spei-
 chereinrichtung für die DVI-I-Schnittstelle eingerich-
 tet ist, zum Blokkieren eines von der Spitzenwert-
 halteschaltung aus fließenden Gleichstroms.
6. Anzeigevorrichtung gemäß Anspruch 2, wobei die
 Steckerbuchse eingerichtet ist, um einen Stecker
 der DVI-I-Schnittstelle eines VGA-auf-DVI-I-Wand-
 lungskabels aufzunehmen, das an seinem DVI-I-
 Stecker eine 5V-Leitung für DDC aufweist, die offen
 oder geerdet ist, wobei DDC für "Display Data Chan-
 nel" steht.
7. Anzeigevorrichtung gemäß einem der Ansprüche 1
 bis 6, wobei die Spezifikationsinformationen EDID
 darstellen, die für eine Plug-and-Play-Funktion not-
 wendig sind, wobei EDID für "Extended Display
 Identification Data" steht.

Revendications

1. Appareil d'affichage (8) permettant d'afficher des
 images sur la base de signaux reçus à partir d'un
 hôte (1), comprenant :
- un réceptacle de connecteur (9) destiné à rece-
 voir un connecteur d'un type d'interface prédé-
 terminé, par l'intermédiaire duquel les signaux
 provenant de l'hôte sont reçus ;
 un moyen de détermination (31) destiné à dé-
 terminer un type d'interface dudit hôte sur la ba-
 se d'une valeur de tension d'une ligne d'alimen-
 tation en courant continu particulière parmi les
 signaux reçus à partir dudit hôte par l'intermé-
 diaire dudit réceptacle de connecteur ;
 une pluralité de moyens de stockage (23 ; 25)
 stockant chacun des informations de spécifica-
 tion relatives à l'affichage pour l'un des types
 d'interface dudit hôte, qui peuvent être connec-
 tés audit appareil d'affichage ; et
 un moyen de sortie (31) destiné à sélectionner
 l'un de ladite pluralité de moyens de stockage
 en réponse à ladite valeur de tension de ladite
 ligne d'alimentation en courant continu particu-
 lière sur la base d'un résultat de détermination
 par ledit moyen de détermination, et à délivrer
 en sortie des informations de spécification du
 moyen de stockage sélectionné desdits moyens
 de stockage à l'hôte, qui correspondent au type
 d'interface déterminé par ledit moyen de déter-
 mination.
2. Appareil d'affichage tel que défini dans la revendi-
 cation 1, dans lequel ledit moyen de détermination
 est agencé pour différencier, en tant que types d'in-
 terface dudit hôte, entre l'interface DVI-I et l'interface
 VGA, où DVI représente une Interface Visuelle Nu-
 mérique Intégrée et VGA représente un Adaptateur
 Graphique Vidéo.
3. Appareil d'affichage tel que défini dans la revendi-
 cation 1 ou 2, dans lequel ladite pluralité de moyens
 de stockage comprennent deux moyens de stocka-
 ge, l'un pour l'interface DVI-I, et l'autre pour l'inter-
 face VGA, ledit moyen de stockage pour l'interface
 DVI-I n'étant alimenté par ledit hôte que lorsque le
 type d'interface est l'interface DVI-I.
4. Appareil d'affichage tel que défini dans la revendi-
 cation 3, comprenant en outre un circuit de maintien

de crête destiné à générer une tension continue sur la base de signaux de synchronisation reçus dudit hôte, ladite tension continue générée par ledit circuit de maintien de crête étant alimentée uniquement audit moyen de stockage pour l'interface VGA et audit moyen de sortie. 5

5. Appareil d'affichage tel que défini dans la revendication 4, comprenant en outre une diode empêchant le reflux disposée entre ledit circuit de maintien de crête et ledit moyen de stockage pour l'interface DVI-I afin de bloquer un courant continu circulant à partir dudit circuit de maintien de crête. 10

6. Appareil d'affichage tel que défini dans la revendication 2, dans lequel ledit réceptacle de connecteur est agencé pour recevoir un connecteur de l'interface DVI-I d'un câble de conversion VGA à DVI-I ayant, au niveau de son connecteur DVI-I, une ligne 5V pour un DDC, qui est ouverte ou mise à la terre, où DDC représente un Canal de Données D'affichage. 15 20

7. Appareil d'affichage tel que défini dans l'une quelconque des revendications 1 à 6, dans lequel lesdites informations de spécification sont des EDID nécessaires pour une fonction Plug-and-Play, où EDID représente des Données D'identification D'affichage Etendues. 25

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Fig.1

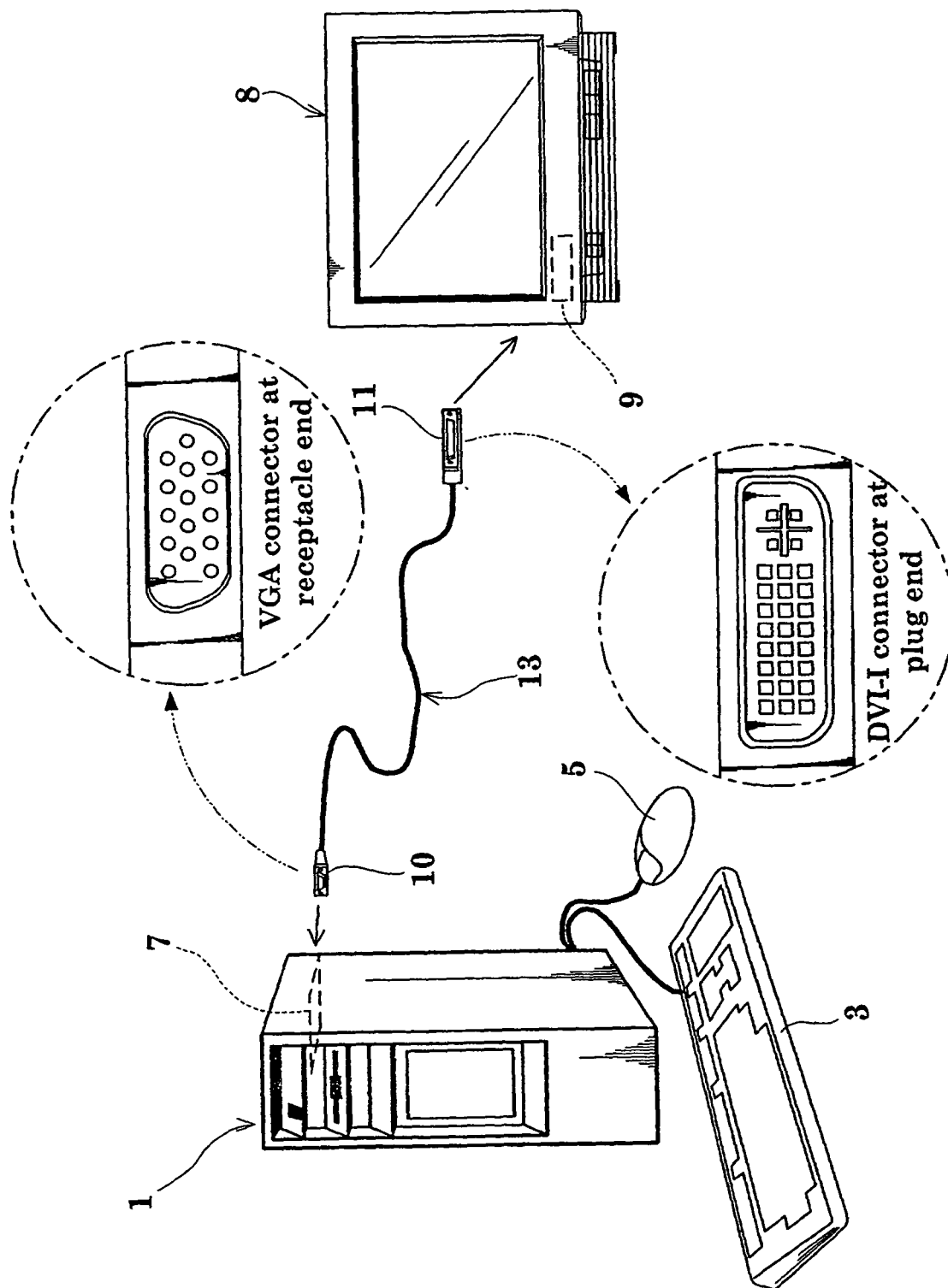


Fig.2

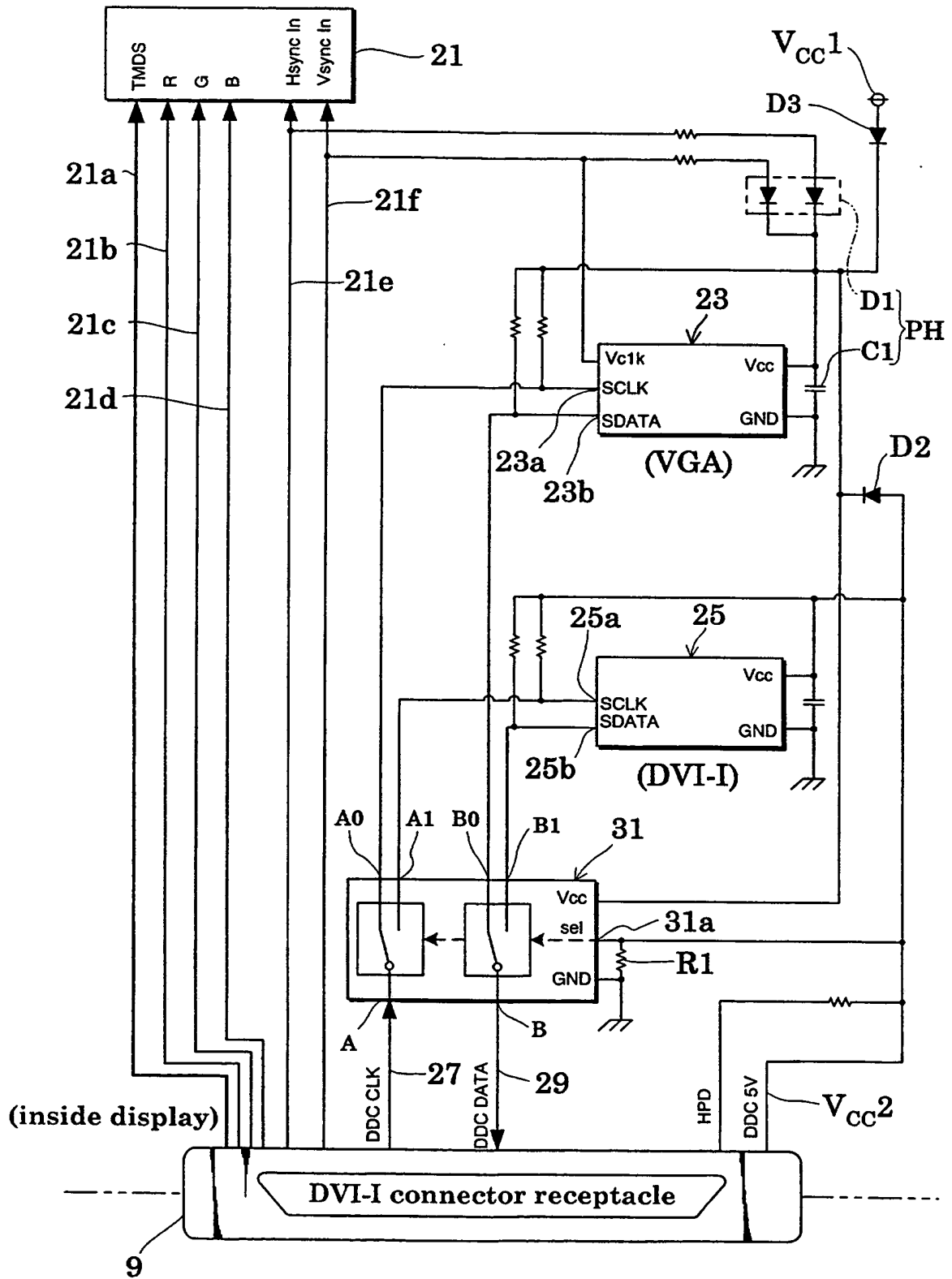
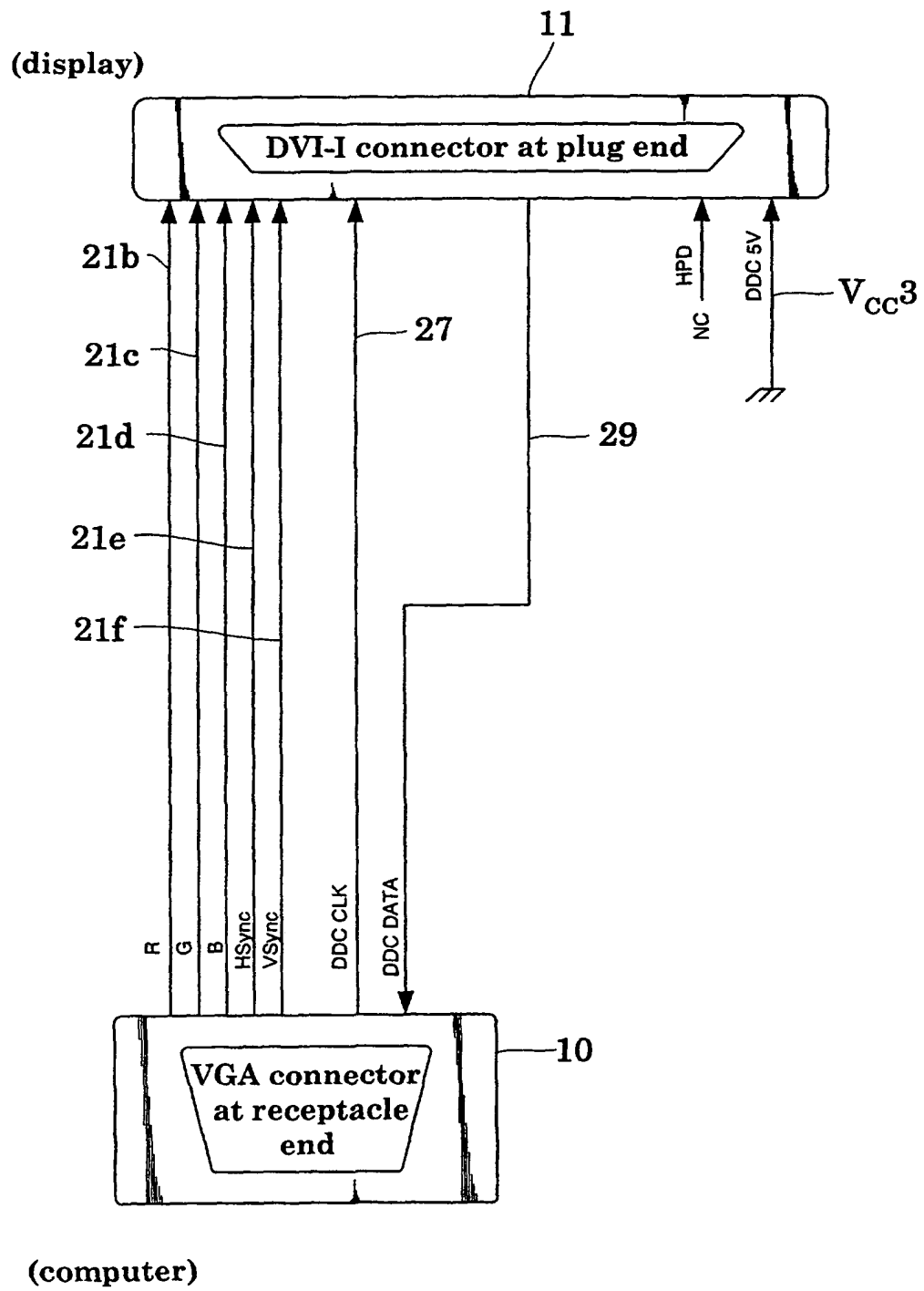


Fig.3



REFERENCES CITED IN THE DESCRIPTION

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